

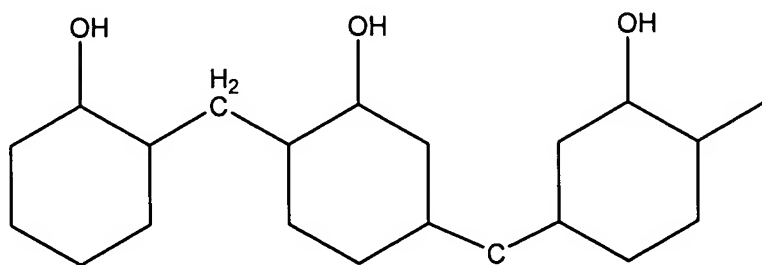
REMARKS

Claims 10-17 have been added. Support for these claims can be found in the specification at least at pages 4-5, 9-14, 26, and 34-41. Claim 1 has been amended to correct a minor typographical error. No new matter has been added and entry is respectfully requested.

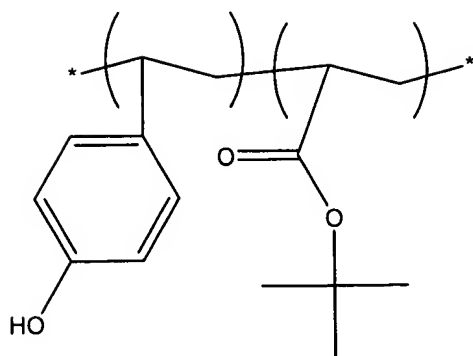
Claims 1-5 and 7-9 have been rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,136,400 to Kobayashi et al. (hereinafter referred to as "Kobayashi") in view of JP 09-236923 to Nakano et al. (hereinafter referred to as "Nakano"). This rejection, which appears on pages 2-4, numbered paragraph 2 of the Official Action, is respectfully traversed.

According to the Official Action, Kobayashi discloses a resin composition "... containing an acid-decomposable group-containing resin (A-4), photoacid generators (B1-5), (B2-5), an acid diffusion controller, and a solvent" as set forth in Table 1 of Kobayashi (pg. 2 of the Official Action). As acknowledged in the Official Action, however, Kobayashi fails to disclose a component (A) having the structure of formula (1) as set forth in Claim 1. In order to remedy this acknowledged deficiency of Kobayashi, the Official Action relies upon Nakano. According to the Official Action, Nakano "... teaches that a photoresist composition containing imidazole derivatives such as *1-benzyl-2-methylimidazole* shows good storage stability and provides resist patterns showing good adhesion to substrate" (emphasis in original, pg. 2 of the Official Action). The Official Action then asserts that "... it would have been obvious to one skilled in the art to include an imidazole derivative compound such as 1-benzyl-2-methylimidazole in Kobayashi's positive tone resin composition of Example 4 in order to obtain good storage stability and provide resist patterns showing good adhesion to substrate".

It is respectfully submitted that the Official Action has failed to establish a *prima facie* case of obviousness. Moreover, Example 4 of Kobayashi is a resist composition comprising a resin designated A-4 (Table 1, Columns 25-26 of Kobayashi). Resin A-4 is a copolymer of p-hydroxystyrene and t-butyl acrylate (Column 25, Lines 6-8 of Kobayashi). In contrast, Nakano is directed exclusively to compositions comprising alkali soluble novolak resins and quinonediazide compounds (See English Abstract of Nakano). It is respectfully submitted that one of ordinary skill in the art would not have been motivated to add an imidazole additive to the resin composition of Example 4 of Kobayashi, which is a p-hydroxystyrene/t-butyl acrylate copolymer based resin composition, based on the teachings of Nakano which are directed exclusively to novolak resin based compositions. Novolak resins have a completely different chemical structure than the p-hydroxystyrene/t-butyl acrylate copolymers of Example 4 of Kobayashi. Moreover, novolak resins result from the condensation of phenols and aldehydes and have a general structure as set forth below:



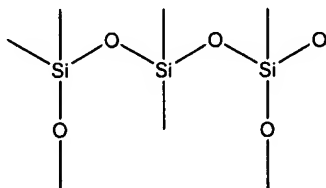
(See pp. 437-438 of Billmeyer, "Textbook of Polymer Science", a copy of which is submitted herewith). In contrast, p-hydroxystyrene/t-butyl acrylate copolymers have a structure as set forth below:



To establish a *prima facie* case of obviousness, there must be a reasonable expectation of success (See MPEP §2143.01). It is respectfully submitted that one of ordinary skill in the art would not have had a reasonable expectation that the proposed combination would have been successful based on the teachings of the cited references. Moreover, one of ordinary skill in the polymer chemistry arts would not reasonably expect an additive (i.e., an adhesion promoter) which is specified for use in one resin system (i.e., Novolak resins) to be similarly effective in a chemically dissimilar resin system. Accordingly, it is respectfully submitted that Claim 1 is patentable over Kobayashi in view of Nakano. Claims 2-5 and 7-9 depend either directly or indirectly from Claim 1 and are therefore also patentable over Kobayashi in view of Nakano for at least the reasons set forth above with respect to Claim 1. Reconsideration and withdrawal of this rejection is therefore respectfully requested.

Claims 1-3 and 6 have been rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent Application Publication No. 2001/0041769 A1 to Iwasawa et al. (hereinafter referred to as "Iwasawa") in view of Nakano. This rejection, which appears on pages 4-5, numbered paragraph 3 of the Official Action, is respectfully traversed.

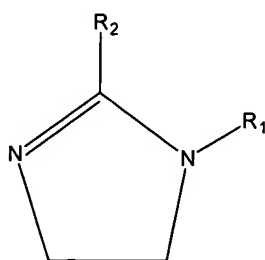
According to the Official Action, Iwasawa discloses resin compositions comprising an alkali soluble polysiloxane resin and a photacid generator (pg. 4 of the Official Action). As acknowledged in the Official Action, however, Iwasawa fails to disclose a compound of formula (1) of Claim 1. In order to remedy this acknowledged deficiency of Iwasawa, the Official Action relies upon Nakano. As set forth above, Nakano is directed to novolak resin systems. In contrast, Iwasawa is directed to silicone based resin systems. Silicone based resins have a chemical structure as set forth below:



(Abstract of Iwasawa). Thus, polysiloxane resins have a structure significantly different than that of the novolak resins disclosed in Nakano. It is respectfully submitted that one of ordinary skill in the art would not have had a reasonable expectation that the proposed combination would have been successful based on the teachings of the cited references. Moreover, one of ordinary skill in the polymer chemistry arts would not reasonably expect an additive (i.e., an adhesion promoter) which is specified for use in one resin system (i.e., Novolak resins) to be similarly effective in a chemically dissimilar resin system. Accordingly, it is respectfully submitted that Claim 1 is patentable over Iwasawa in view of Nakano. Claims 2, 3 and 6 depend either directly or indirectly from Claim 1 and are therefore also patentable over Iwasawa in view of Nakano for at least the reasons set forth above with respect to Claim 1. Reconsideration and withdrawal of this rejection is therefore respectfully requested.

Newly added Claims 10-17 depend either directly or indirectly from Claim 1 and are therefore also patentable over the cited references for at least the reasons set forth above with respect to Claim 1.

Claims 10-13 can be further distinguished from the cited references. Moreover, Claims 10-13 further define compound (A). It is respectfully submitted that Nakano fails to disclose a compound (A) as set forth in any of Claims 10-15. In particular, Nakano discloses a compound of the following formula:



wherein R₁ is a vinyl group, a benzyl group, a C1-C5 alkyl group or a hydrogen atom and wherein R₂ is a C1-C5 alkyl group or a hydrogen atom (see paragraph [0010] of machine translation of Nakano, a copy of which is submitted herewith). This formula does not encompass a Compound A as defined in any of Claims 10-15. Accordingly, it is respectfully submitted that Claims 10-14 can be further distinguished from the cited references.

CONCLUSION

In view of the above amendments and remarks, Applicant respectfully requests a Notice of Allowance. If the Examiner believes a telephone conference would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

Respectfully submitted,

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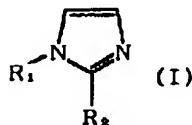
Machine Translation of JP 09-236923

CLAIMS

[Claim(s)]

[Claim 1] It is a degree type (I) to the basic presentation which consists of alkali fusibility novolak mold resin and a quinone diazide radical content compound.

[Formula 1]



It is the positive type photoresist constituent characterized by making the compound expressed with (R1 expresses a vinyl group, benzyl, the alkyl group of C1-C5, and a hydrogen atom among a formula, and R2 expresses the alkyl group of C1-C5, and a hydrogen atom) contain.

[Claim 2] The constituent according to claim 1 whose additions of the compound expressed with the aforementioned formula (I) are per [0.1] aforementioned basic presentation 100 weight section - 5 weight sections.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the positive type photoresist constituent which induces radiations, such as ultraviolet rays, far ultraviolet rays (an excimer laser etc. is included), an electron ray, an ion beam, and an X-ray. It is related with the new positive type photoresist constituent which can form the resist pattern excellent in adhesion with the substrate in manufacture of a semiconductor device, LCD (thin film transistor), etc. in more detail.

[0002]

[Description of the Prior Art] Conventionally, in the manufacture process of liquid crystal display components, such as semiconductor devices, such as IC and LSI, and LCD, micro processing by the photo etching method is performed. By this photo etching method, a photoresist is applied on a substrate and the method of etching this substrate at a it top by using as a protective coat the resist pattern which developed negatives after irradiating activity beams of light, such as ultraviolet rays, and was obtained through the mask pattern is taken. And it is known that the combination of the alkali fusibility novolak mold resin for coat formation and the sensitization component which consists of a quinone diazide radical content benzophenone system compound is suitable as a photoresist constituent used in this approach (for example, a U.S. Pat. No. 4377631 specification, JP,62-35349,A, JP,1-142548,A, JP,1-179147,A).

[0003] By the way, in order to etch a substrate with a sufficient precision by the photo

etching method in manufacture of a semiconductor device, LCD, etc., the adhesion of a resist pattern and this substrate is important, and if this adhesion is bad, the amount of interlocking at the time of wet etching will become large, and it happens and is inconvenient [the short circuit of a pattern]. On the other hand, it is known by blending imidazoline that the adhesion of the positive type photoresist to oxide may be raised (JP,51-47574,A).

[0004] Moreover, it is known to metal substrates, such as a silicon substrate and a tantalum, by blending benzimidazoles and the poly benzimidazole that adhesion may be improved (JP,6-27657,A). However, there is a fault that the preservation stability of a resist is spoiled, by adding these compounds.

[0005] In addition, about the possibility of the improvement in adhesion about what a vinyl group, benzyl, and an alkyl group attached to the substituent, it is not known in the same imidazole derivatives.

[0006]

[Problem(s) to be Solved by the Invention] This invention is made for the purpose of offering the positive type photoresist constituent using alkali fusibility novolak mold resin which can form the resist pattern which was excellent in adhesion to the substrate in manufacture of a semiconductor device, LCD, etc., without spoiling the preservation stability of a resist.

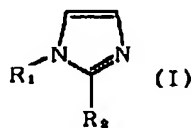
[0007]

[Means for Solving the Problem] this invention person etc. came to complete this invention for the ability of that purpose to be attained by adding a certain kind of imidazole derivatives based on a header and this knowledge to the constituent which consists of alkali fusibility novolak mold resin and a quinone diazide radical content compound, as a result of repeating research wholeheartedly in order to obtain the constituent which suits the above-mentioned purpose.

[0008] That is, this invention is a degree type (I) to the basic presentation which is a positive type photoresist constituent and consists of alkali fusibility novolak mold resin and a quinone diazide radical content compound.

[0009]

[Formula 2]



[0010] It is characterized by making the compound (imidazole derivatives) expressed with (R1 expresses a vinyl group, benzyl, the alkyl group of C1-C5, and a hydrogen atom among a formula, and R2 expresses the alkyl group of C1-C5, and a hydrogen atom) contain as an adhesion enhancement agent.

[0011] In the constituent of this invention, alkali fusibility novolak mold resin is used as matter for coat formation. The resultant of phenols and aldehydes is mentioned about this alkali fusibility novolak mold resin. As phenols, a phenol, o-, m-, or p-cresol, 2, 5-xyleneol, 3, 6-xyleneol, 3, 4-xyleneol, 2, 3, a 5-trimethyl phenol, 4-t-butylphenol, 2-t-butylphenol, 3-t-butylphenol, 2-ethylphenol, 3-ethylphenol, 4-ethylphenol, 3-methyl-6-t-butylphenol, 4-methyl-2-t-butylphenol, Aromatic series hydroxy compounds, such as 2-

naphthol, 1, 3-dihydroxy naphthalene, 1, 6-dihydroxy naphthalene, 1, and 7-dihydroxy naphthalene, are mentioned. As aldehydes, formaldehyde, a paraformaldehyde, an acetaldehyde, a propyl aldehyde, a benzaldehyde, a phenyl aldehyde, etc. are mentioned. The reaction of phenols and aldehydes is performed under existence of a catalyst, and it is carried out in PARUKU or a solvent. As a catalyst, organic acids (formic acid, oxalic acid, p-toluenesulfonic acid, trichloroacetic acid, etc.), inorganic acids (phosphoric acid, a hydrochloric acid, a sulfuric acid, perchloric acid, etc.), and divalent metal salts (zinc acetate, magnesium acetate, etc.) are mentioned.

[0012] In the constituent of this invention, a quinone diazide radical content compound is used as a photosensitive component. As this quinone diazide radical content compound, a perfect ester compound, a partial ester compound, etc. with polyhydroxy benzophenones, such as a 2, 3, 4-trihydroxy benzophenone, 2, 3 and 4, and 4'-tetra-hydroxy benzophenone, a naphthoquinone -1, a 2-diazido-5-sulfonic acid or a naphthoquinone -1, and a 2-diazido-4-sulfonic acid can be mentioned, for example.

[0013] Moreover, other quinone diazide radical content compounds, for example, orthochromatic benzoquinone diazido, These nuclear substitution derivatives, such as orthochromatic naphthoquinonediazide, orthochromatic anthraquinone diazido, or orthochromatic naphthoquinonediazide sulfonates, Furthermore, a compound, for example, a phenol, with orthochromatic naphthoquinone sulfonyl chloride, a hydroxyl group, or the amino group, p-methoxy phenol, dimethylphenol, a hydroquinone, bisphenol A, A naphthol, a carbinol, a pyrocatechol, pyrogallol, the pyrogallol monomethyl ether, A resultant with pyrogallol -1, 3-wood ether, a gallic acid, the gallic acid that left a part of hydroxyl group, and was esterified or etherified, an aniline, p-amino diphenylamine, etc. can be used. These may be used independently and may be used combining two or more kinds.

[0014] These quinone diazide radical content compounds can be manufactured by carrying out condensation of said polyhydroxy benzophenone and naphthoquinone -1, 2-diazido-5-sulfonyl chloride or a naphthoquinone -1, and the 2-diazido-4-sulfonyl chloride into suitable solvents, such as dioxane, under alkali existence, such as triethanolamine, carbonic acid alkali, and carbonic acid hydrogen alkali, and perfect-esterifying or partial esterifying.

[0015] In the constituent of this invention, it is required to use the compound chosen from the imidazole derivatives expressed with the aforementioned formula (I) as an adhesion enhancement agent.

[0016] As an example of imidazole derivatives expressed with the aforementioned formula (I), 1-vinyl imidazole, a 1-benzyl-2-ethyl imidazole, etc. are mentioned.

[0017] In this invention, one sort of these imidazole derivatives may be used, and they may be used for two or more sorts, combining.

[0018] moreover, the total quantity 100 weight section of the basic presentation which the addition of the imidazole derivatives of an adhesion enhancement agent becomes from alkali fusibility novolak mold resin and a quinone diazide radical content compound -- receiving -- 0.05 - 20 weight section -- it is preferably chosen in the range of 0.5 - 10 weight section. If improvement effectiveness in adhesion with this amount sufficient in under the 0.05 weight section is not acquired but 20 weight sections are exceeded, since the effectiveness of the improvement in adhesion is not acquired considering an amount but sensibility also falls, it is not desirable.

[0019] in addition, the rate of the alkali fusibility novolak mold resin under basic presentation in the constituent of this invention, and a quinone diazide radical content compound -- the former 100 weight section -- receiving -- the latter 5 - 40 weight sections -- it is within the limits of 10 - 30 weight section preferably.

[0020] The constituent of this invention can carry out addition content of the component used [sensitizer / which raises the color for improving the visibility of the resin for improving the engine performance of the additive which has compatibility if needed further, for example, the resist film, etc., a plasticizer, a stabilizer, a surface active agent, and the resist pattern after development, and the sensitization effectiveness] commonly.

[0021] The constituent of this invention is used in the form of the solution which dissolved alkali fusibility novolak mold resin, a quinone diazide radical content compound, a certain kind of imidazole derivatives, and the various addition components used according to a request in the suitable solvent.

[0022] As a solvent, ketones, such as 2-heptanone, an acetone, a methyl ethyl ketone, 1 and 1, and a 1-trimethyl acetone Ethylene glycol mono-acetate, propylene glycol mono-acetate, The monomethyl ether of diethylene-glycol or diethylene-glycol mono-acetate, Polyhydric alcohol, such as the monoethyl ether, the monopropyl ether, the monobutyl ether, or the monophenyl ether, and the derivative of those, Ester, such as ring type ether like dioxane, and ethyl lactate, methyl acetate, ethyl acetate, butyl acetate, methyl propionate, pyruvic-acid ethyl, 3-methoxy methyl propionate, 3-ethoxy methyl propionate, is mentioned. These solvents may be used independently, and even if it uses combining two or more sorts, they are not cared about. especially a limit will not be carried out, if the amount used is homogeneous, and spreading which can do the spreading film without a pinhole and coating unevenness is possible for it, it comes out on a substrate and there is. Usually, it prepares so that the amount of solvents may become 50 - 97% of the weight to all resists.

[0023] One example of the suitable operation of the constituent of this invention is shown below.

[0024] First, the positive type photoresist liquid containing each aforementioned component is applied with a spinner on a substrate, it dries and a photoresist layer is formed. A low pressure mercury lamp, a high pressure mercury vapor lamp, an ultrahigh pressure mercury lamp, the arc light, a xenon lamp, etc. are used for this, and ultraviolet rays are exposed through a predetermined mask pattern.

[0025] Next, if this is immersed in a weak alkaline water solution like a developer, for example, 1 - 10% of the weight of a tetramethylammonium hydroxide water solution, dissolution removal is carried out alternatively and the exposed part can form a resist pattern faithful to a mask pattern on a substrate. Subsequently, after etching the substrate which exposed the obtained resist pattern as a mask by the well-known approach, a circuit pattern is formed on a substrate by exfoliating a resist pattern.

[0026]

[Example] Below, an example explains this invention further at a detail. However, this invention is not limited at all by these examples.

[0027] 100g (weight average molecular weight 5,000) of cresol novolak mold resin which manufactured 1m-cresol of examples, and p-cresol with the conventional method using what was mixed by the weight ratio 4:6, The naphthoquinone -1 of a 2, 3, 4, and 4'-tetra-hydroxy benzophenone, 20g of 2-diazido-5-sulfonate, The positive type photoresist

solution which dissolved and prepared 1-vinyl imidazole 6g to ethylene-glycol-monoethyl-ether-acetate 500g On the substrate which made the silicon nitride deposit on a glass substrate, it is 1.5 micrometers of thickness. After carrying out spinner spreading so that it may become, And it exposed using contact aligner PLA-500F (Canon, Inc. make) through the test pattern mask. [on the hot plate] [for 110 degree x 120 seconds] [0028] Subsequently, after removing the exposure part and forming a resist pattern on a silicon nitride by being immersed for 60 seconds into a 2.38-% of the weight tetramethylammonium hydroxide water solution, the silicon nitride was etched by being immersed for 20 minutes into high grade buffered fluoric acid (Hashimoto formation shrine make) by using as a mask the silicon nitride which, and was exposed. [within the convection oven] [for 130 degree x 30 minutes] in order [subsequently,] to evaluate the adhesion of a resist pattern and a silicon nitride -- an optical microscope -- 10 micrometers the result of having observed the amount of interlocking of the silicon nitride by etching with a pattern -- the amount of interlocking -- 1 micrometer it is -- good adhesion was checked.

[0029] the result of having etched the silicon nitride like the example 1 except having replaced 1-vinyl imidazole of example 2 example 1 with 1-benzyl-2-methylimidazole, and subsequently having evaluated the adhesion of a resist pattern and a silicon nitride -- the amount of interlocking -- 1 micrometer it is -- good adhesion was checked.

[0030] the result of having etched the silicon nitride like the example 1 except having not blended 1-vinyl imidazole of example of comparison 1 example 1, and subsequently having evaluated the adhesion of a resist pattern and a silicon nitride -- the amount of interlocking -- 3 micrometers it was .

[0031] the result of having etched the silicon nitride like the example 1 except having replaced 1-vinyl imidazole of example of comparison 2 example 1 with benzimidazole, and subsequently having evaluated the adhesion of a resist pattern and a silicon nitride -- the amount of interlocking -- 1 micrometer it is -- good adhesion was checked. However, this resist changed the color of this resist to dark dark reddish-brown from the usual dark reddish-brown one day after benzimidazole addition, and deterioration of a resist was accepted clearly.

[0032]

[Effect of the Invention] According to the constituent of this invention, the resist pattern excellent in adhesion with a semiconductor device or the substrate in manufacture of LCD can be formed, without spoiling the preservation stability of a resist.

TEXTBOOK OF POLYMER SCIENCE

THIRD EDITION

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A Wiley-Interscience Publication

John Wiley & Sons

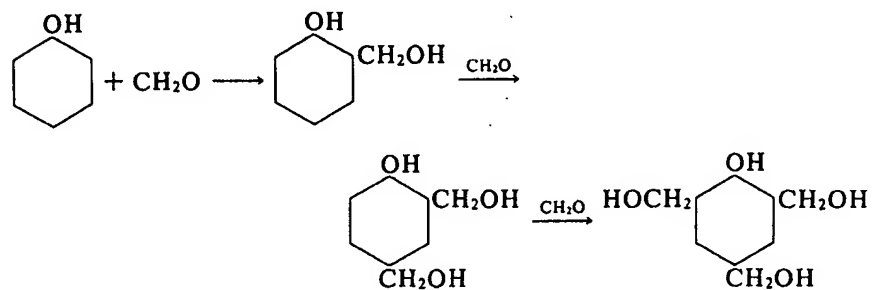
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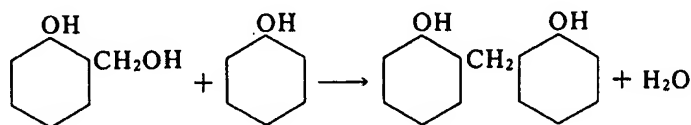
resins continued to rise at about 15% per year, reaching a peak of about 1.3 billion lb in 1979. Severely hit by the depression because of major uses in plywood and other construction uses, sales dropped 44% to about 0.97 billion lb† in 1982, at an average price of \$0.45 per pound.

Reactions of Phenol and Formaldehyde. Phenols react with aldehydes to give condensation products if there are free positions on the benzene ring ortho and para to the hydroxyl group. Formaldehyde is by far the most reactive aldehyde and is used almost exclusively in commercial production. The reaction is always catalyzed, either by acids or by bases. The nature of the product is greatly dependent on the type of catalyst and the mole ratio of the reactants.

The first step in the reaction is the formation of addition compounds known as methylol derivatives, the reaction taking place at the ortho or para position:



These products, which may be considered the monomers for subsequent polymerization, are formed most satisfactorily under neutral or alkaline conditions. In the presence of acid catalysts, and with the mole ratio of formaldehyde to phenol less than 1, the methylol derivatives condense with phenol to form, first, dihydroxy-diphenyl methane:

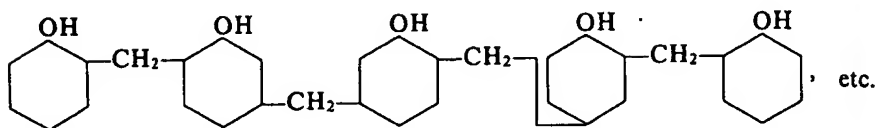


and, on further condensation and methylene bridge formation, fusible and soluble

†Beginning in 1981, phenolics production and sales volumes were reported as gross weights including solvents, roughly 85% higher than the figures cited.

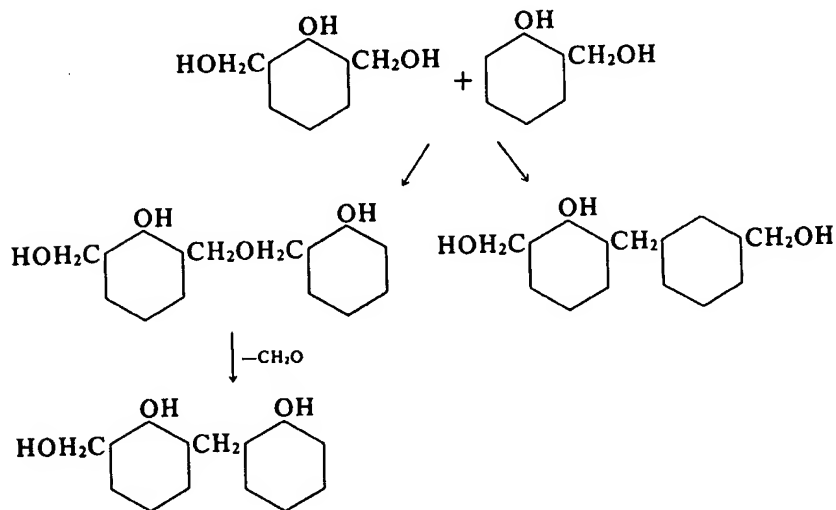
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linear low polymers called *novolacs* with the structure



where ortho and para links occur at random. Molecular weights may range as high as 1000, corresponding to about ten phenyl residues. These materials do not themselves react further to give crosslinked resins, but must be reacted with more formaldehyde to raise its mole ratio to phenol above unity.

In the presence of alkaline catalysts and with more formaldehyde, the methylol phenols can condense either through methylene linkages or through ether linkages. In the latter case, subsequent loss of formaldehyde may occur with methylene bridge formation:



Products of this type, soluble and fusible but containing alcohol groups, are called *resoles*. If the reactions leading to their formation are carried further, large numbers of phenolic nuclei can condense to give network formation.

In summary, the four major reactions in phenolic resin chemistry are (a) addition to give methylol phenols, (b) condensation of a methylol phenol and a phenol to give a methylene bridge, (c) condensation of two methylol groups to give an ether bridge, and (d) decomposition of ether bridges to methylene bridges and formaldehyde, the latter reacting again by the first mode.